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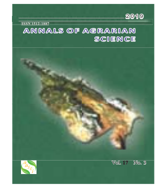

The Plum (Prunus domestica) Cuticle, its components and their impact on the drying process

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A B S T R A C T

The Main aim of this research is understanding how to carried our drying process for the two varieties of plum: ‘‘Shavkliava’’ (local) and ‘’Stanley’’ (introduced) according of cuticle performance. The four fractions was take out from the isolated cuticle: epicuticular wax, intracuticular wax, triterpene acids, and cutin. All these have been analyzed. Obtained data according to the varieties is folowing: ‘Shavkliava’ - 370-478-594-980 $\mu g /cm^2$ and ‘Stanley’ is 625-440-770-1100 $\mu g /cm^2$. The optimal parameters of the blanching was established: ‘Shavkliava’ NaOH concentration 0.5%, 20-30 seconds of exposure, temperature 90^0C; ‘Stanley’ 0.5 % - 30 seconds 95^0C respectively. In such conditions only epicuticular wax is moved off. When there is a high concentration – 1 % NaOH, the intracuticular wax, the total number of phenols and terpene acids decreased, which significantly reduces the dry product’s quality parameters. Treatment involves stopping the oxidation process temporarely. In connection with this, it determined that the phenol compounds in the initial samples and after drying.With the impact of optimal conditions for treatment, the total number of common phenols is significantly more and consists 35.5% for ‘Shavkliava’, 30 % for ‘Stanley’. Drying was carried out in three temperature conditions gradually 40-45^0C, 60-65^0C, 75-85^0C.

Keywords: Variety, Epicuticular wax, Blanching, Triterpene acids, Temperature, Common phenols

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1. Introduction

The demand on the dry plum increased significantly because of its useful properties. According to the existing information, by proved high confidence, it is considered as a product having not only important nutritional but functional features as well. This is one of the important product which is characterized by high antioxidant content. This feature highly depend on the content of phenolic compounds. It was established by research that this is basically Hydroxycinnamic acids like – neo-chlorogenic and chlorogenic acid [1-3]. In this regard, well known that the skin of plums is especially distinguished [4,5].

Actually, Triterpenoids are counted as biologically active substances, which are part of the cuticle. It is considered that they represent essential components for human health and have various biological effects: they can reduce the risk of chronic diseases; at the same time, they have antiviral, antibacterial and anti-cancerogenic action; they could lower cholesterol level as well [6- 8].

The primary purpose during of regular drying process is the maximum keeping of phytochemical ingredients and reduction of the quantity of water to the level, which leads to long and proper storage.

During the drying process, the water from the cells moves to the cuticle, but epicuticular wax prevents the evaporation process - to accelerate this process it is necessary to remove this barrier.

Fruit species and varieties highly differ according to cuticle contents and types, and it is necessary to provide the specific procedures before of start drying process. For instance, For Tart cherry treatment, it is recommended to use 2 % of oleic acid ethyl ester; the temperature must be 23^{0}C, during of 1 min. According of literature data Exposure by high temperature around 60^{0}C, in this case has a negative impact. [9].

For the plum, it is used 4 % etiolate, 1% NaOH, in two temperature regimes -23^{0}C and 60^{0}C. Better results will be obtained, in case of treatment with 1 % KOH solution, by temperature 60^{0}C, 1 min of exposure [10]. Treatment of grapes appeared effective with 6% K_2CO_3 solution, in temperature 50^{0}C, 2 min of exposure [11]. The experiments showed that the treatment of plum is recommended with 1 % NaOH solution, in the temperature 85^{0}C [12]. For blueberry treatment, it is used 0.1 % n NaOH solution, temperature 70°C [13]. Based on the analysis it is revealed that the pretreatment procedures significantly reduce drying time and decreases accordingly energy consumption [14,15].

Based on this review is cleared that the data are quite differ according to biological and genetic properties of fruits. Therefore, it is necessary, in each cases for each fruits should be selected that the proper substances and the optimal parameters for treatment.

The goal of the research is to determine the quantitative indicators of the cuticle components of two plum varieties, as well the selection the parameters for blanching and study the impact of various types of pretreatment on the cuticle components and the oxidation intensity of the phenol compounds during drying process.

2. Materials and methods

The two widespread plum varieties of 'Shavkliava' (local) and *'Stanley'* (introduced) were selected for given research. The experimental samples were taken from SRCA jigaura research station in the period of optimal ripening phases of these varieties – they has the characteristic color of the variety, aroma, taste; it is slightly soft with the touch of the finger.

The efficiency of drying process is affected by the pretreatment procedures, which are significantly related to the size of cuticle's membrane. In this regard, the components of the cuticle are determined: epicuticular wax, intracuticular wax, triterpene acids, and cutin.

For the take out the cuticle, the skin of the plum is placed in ammonia solution of the oxalic acid, whose pH is 4,0, within of 40 hours, at temperature - 37^{0}C. The received material is cleaned with water, dried and packed in a filter paper and is placed in Soxhlet apparatus. The following scheme was apply for the fractionation of the cuticle (Fig. 1).

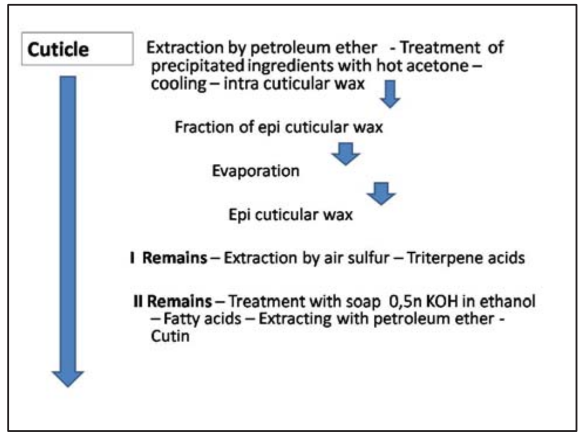

Fig. 1. *Scheme of fractionation of the cuticle*

In the experimental samples of phenol compounds, the total number is determined by Folin-ic-Chiokalte method, on the spectrometer, on the wavelength of 765 nm. The standard solution is prepared by using Gallic acid.

It is well known, that in the drying technology pretreatment (blanching) is essential, which aims to increase the drying speed. Also, it provides for a reduction-oxidation process at a high temperature by inactivation of the enzyme.

In this regard, 0.5 and 1 % NAOH solution were used. In both cases, exposure was 20-30 sec., the blanching temperature were differ according of varieties for 'Shavkliava' - 90^{0}C*, for* 'Stanley' - 95^{0}C.

Plum drying is carried out in three stages under various temperature conditions: A - 40-45 ^{0}C, 6 hours of exposure, B - 60-65 ^{0}C, 4 hours of exposure; C - 75-85 ^{0}C, drying continues until a water content is decreasing till of 25 %.

3. Results and discussions

According of Performed research revealed that the plum cuticle data varies significantly according to the epicuticular wax and triterpene acid content for the different varieties: 'Shavkliava' - 370-594 μg /cm^2 and 'Stanley' - 625-770 μg /cm$^{2.}$

Intracuticular wax content data is almost the same, there is no change regarding cutin content (Table.1).

Table 1. *Plum cuticle components, μg /cm²*.

Variety	Epi- cuticular	Intracuticular	Teterpene Acid	Cutin
'Shavkliava'	370	478	594	986
'Stanley'	625	440	770	1100

It is very important that Wax is well dissolved in alkaline solution, and this is considered during plum drying process – epicuticular wax becomes separate from cuticle and water starting intensively evaporate. Other hand, the concentration is effected on this process as well and has vital importance.

During of 1% NaOH solution treatment, when the duration 20-30 seconds, the 'Shavkliava' temperature is 90 ^{0}C and 'Stanley' temperature is 95 ^{0}C, the quite thin net cover is formed on the skin. Other damage, which might affect the drying process, have not been observed visually, the Only difference occurs for the 'Shavkliava' on 95^{0}C, when juice is starting leaching.

The above analysis showed that quantitative indicator of cuticle components had changed significantly. Epicuticular wax is eradicated, intracuticular wax and triterpene acids-decreased (Table 2).

It is very important to note, that the change is more higher in the case of 'Shavkliava': intracticular wax - 29.3%, triterpenes acids - 21.7%. In the case of 'Stanley' is only - 17.2% and 13.0% (Fig. 2.)

Table 2. *Plum cuticle components after initial treatment, μg /cm²*

Temperature, ^{0}C	NaOH Solution Concentration, %	Epicuticular Wax	Intracuticular Wax	Triterpene Acids	Cutin
'Shavkliava'					
90	0.5	0	467.0	573.0	962.0
90	1.0	0	338.0	465.0	980.0
'Stanley'					
95	0.5	0	470	752	1120.0
95	1.0	0	364	670	1097.0

* Exposition 20-30 seconds

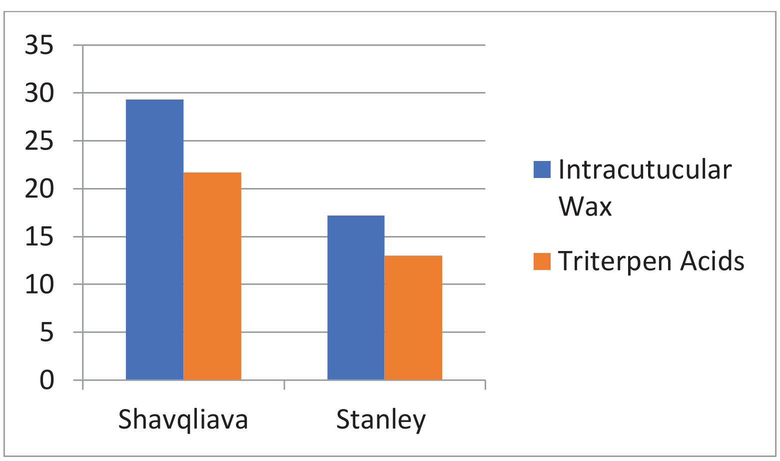

Fig. 2. *Rates of Epicuticular wax and triterpene acids in conditions of 1.0% NaOH solution treatment.*

It was found that Only epicuticular wax was removed after treatment with relatively low 0.5% NaOH solution. The results show that correct selection of pre-treatment (blanching) parameters is vitally important, which increases drying speed. Also, it considers reducing oxidation process within high-temperature conditions by enzyme inactivation.

The data of the total amount of phenols is represented in initial samples and after the drying process. They are decreased in case of treatment with 1.0% NaOH solution. (Table 3).

As determined, The activation of oxidation process is caused by decreasing the number of intracuticular wax and triterpene acid by increasing penetration of oxygen. According of data, in the case of 'Shavkliava' it is reduced by 30% and by 35.5% in case of 'Stanley' (Fig. 3).

It should be noted that the removal of the intracuticular wax reduces the quality of dried plum- it is less elastic and less shining.

The differentiation of drying temperature has some theoretical explanation – on 40-45 ^{0}C temperature the enzyme-invertase is activated inside the pulp of the plum, as a result of this process the hydrolysis of sucrose is taking place; Monosaccharide's are getting into non enzymatic reaction with amino acids on 60-65^{0}C temperature and as a result the melanoidins are formed, which could increase the antioxidant activity [16].

It is interesting that in the 75-85^{0}C temperature conditions, formation of dark pigments and aromatic substances is continued, intracuticular wax is takes out, as a consequence of this process dry plum fruit obtains required specific taste, aroma, color, and shining.

4. Conclusion

It is very important to perform initial treatment correctly during of plum drying technology: appropriately designated concentration, exposition, and temperature of used substances. All this approaches determines biologically active elements - phenolic compounds, well-preserved triterpene acids, and suitable market appearance.

The optimal parameters of the blanching was established: *'Shavkliava'* NaOH concentration 0.5%, 20-30 seconds of exposure, temperature 90^{0}C; *'Stanley'* 0.5 % - 30 seconds 95^{0}C respectively. In such conditions only epicuticular wax is moved off. When there is a high concentration – 1 % NaOH,

Table 3. *Change of phenolic compounds during the plum drying process, μg /100g.*

Variety	Initial	Dried Product	
		I version*	II version**
'Shavkliava'	172	409	280
Stanely	210	580	374

I version* - 0.5% NaOH Solution Treatment

II version** - 1.0% NaOH Solution Treatment

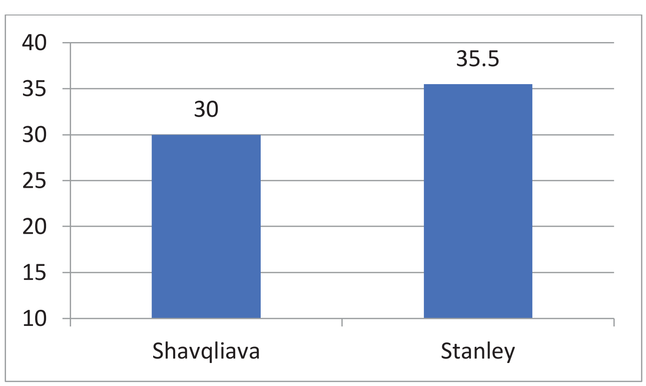

Fig. 3. *decreasing rate of phenolic compounds in the drying process during 1.0% NaOH solution treatment, %*

the intracuticular wax, the total number of phenols and terpene acids decreased, which significantly reduces the dry product's quality parameters

5. Acknowledgement

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